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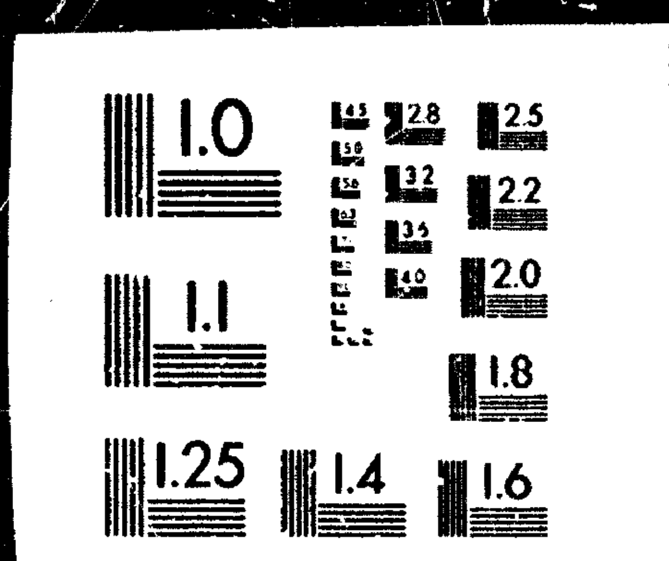

PB81-246209

Special Investigation Report
Recent Accident History of Hot Box
Detector Data Management

(U.S.) National Transportation Safety Board
Washington, DC

11 Aug 81

PB81-246209

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

SPECIAL INVESTIGATION REPORT

RECENT ACCIDENT HISTORY OF HOT BOX DETECTOR DATA MANAGEMENT

NTSB-SIR-81-1

UNITED STATES GOVERNMENT

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16. Abstract

Since 1976, the Safety Board has investigated nine accidents involving trains which derailed due to the failure of overheated journal bearings that had been identified by a trackside infrared hot box detector prior to the accident. None of these accidents were declared major accidents since there were no fatalities and only one personal injury. The property damage was extensive ranging from $190,000 to $1,080,000 and averaging $533,000 per accident.

The Safety Board noted that three of these nine accidents occurred in the first 5 months of 1981; the occurrence of these accidents counters the general trend of a declining number of railroad accidents due to overheated journal bearings. The Board initiated this special investigation to explore the reasons for the declining rate of railroad accidents caused by overheated journal bearings and to identify areas where improved control and handling of hot box detector data may result in a further reduction of these accidents.

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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

SPECIAL INVESTIGATION REPORT

Adopted: August 11, 1981

RECENT ACCIDENT HISTORY OF HOT BOX DETECTOR DATA MANAGEMENT

INTRODUCTION

Railroad journal bearings 1/ serve as part of the primary suspension system in the truck of railroad freight cars and locomotives. The two basic types of journal bearings are the conventional solid bearing and the roller bearing. Conventional solid bearings are lubricated by oil while most roller bearings are lubricated by grease. In the event of a lubrication failure, increased friction heats the journal bearing rapidly and the heat is transmitted to the journal 2/ and the wheel. As the rail vehicle progresses along the track, the bearing temperature increases until the bearing eventually fails. After the bearing fails, the journal continues to absorb heat until it loses strength and can no longer support the weight of the car or locomotive. When the journal fails, the truck side falls to the track structure and frequently results in a derailment of one or more cars in the train.

In recent years, the number of accidents caused by broken journals due to overheated journal bearings has been declining. Two reasons for the decline are the increased use of hot box detectors (trackside devices which sense and record journal bearing temperatures as the train passes) and the increased use of roller bearings rather than solid bearings. Although this progress is commendable, the Safety Board is concerned that the use of data taken from a hot box detector after an overheated journal bearing has been identified is not sufficiently controlled to achieve maximum safety effectiveness.

The purpose of this Special Investigation is to document the progress that has been made in the reduction of journal failures caused by overheated bearings, to explore the reasons for such improvement, and to identify areas where improved control and handling of hot box detector data can result in a further reduction of journal failures caused by overheated journal bearings.

INVESTIGATION

General Trends

One of the criteria used to measure the utilization of railroads is the number of miles that a ton of revenue freight is carried. The numerical factor, known as revenue ton-miles, is a useful tool for comparing accident exposure rates for American railroads. Revenue ton-mile data from 1976 through 1980, the period covered in this investigation, are shown in Table 1.

1/ A combination of rollers or a solid block of brass or bronze which transmits loads from the vehicle to an axle.
2/ That portion of an axle in actual contact with a journal bearing.

Table 1.—Revenue Ton-Miles. */
(in millions)

Year	Ton-Miles
1976	794,059
1977	826,292
1978	858,105
1979	913,669
1980	918,958

*/ Source: Association of American Railroads.

While railroads have been moving an increasing amount of revenue freight each year for the past 5 years, there has been a general decline in the number of accidents reported to the Federal Railroad Administration (FRA) by the nation's railroads for the same period. Although the accident data show a 10-percent increase in the third year from the first year of the 5-year period, an 18-percent decrease occurred in the fifth year of the period, and the general trend over the period indicates a gradually declining rate. (See table 2.)

Table 2.—Train Accidents. */
1976 - 1980

Year	No. of Accidents
1976	10,248
1977	10,362
1978	11,277
1979	9,740
1980	8,451

Federal Railroad Administration (FRA) data for the 5-year period from 1976 through 1930 show a decline in overheated journal bearing accidents from 256 in 1976 to 178 in 1980, with the average annual number during this period being 237. The 1980 accident figure was 25 percent below the average for the 5-year period and over 30 percent below the 1976 accident figure. In addition, between 1976 and 1980, the number of journal bearing accidents declined at a faster rate than all types of train accidents while the actual ton-miles or freight carried increased each year. Table 3 gives the FRA overheated journal bearing accident data for the period examined.

*/ Source: Federal Railroad Administration. (Data based on property damage reporting threshold of $1,750 in 1976, $2,300 in 1977 and 1978, $2,900 in 1979 and 1980).

Table 3.—Number of Accidents Caused by Overheated Journal Bearings. */

Year	Accidents
1976	256
1977	254
1978	266
1979	230
1980	178

*/ Source: Federal Railroad Administration.

The two basic reasons for the 25-percent to 30-percent decline in the number of accidents due to overheated journal bearings are the increased use of trackside hot box detectors and the increased use of roller bearings rather than solid bearings.

The effect of roller bearings on the decline of overheated journal bearing accidents from 1976 to 1980 is related to the service life of roller bearings (see appendix A) and to the 12-percent increase in use of roller bearings in the railroad fleet. (See table 4.)

Table 4.—Percentage of Active Freight Car Fleet Equipped With Roller Bearings. */

Year	Percent
1976	64
1977	68
1978	68
1979	72
1980	76

*/ Source: Association of American Railroads

Because roller bearings have a longer service life in terms of miles traveled per overheated bearing failure than conventional solid bearings (a ratio of approximately 16 to 1), a 12-percent increase in the use of roller bearings increased the average miles traveled per overheated bearing failure for the railroad fleet by 20 percent from 1976 to 1980. (See appendix B.) During the same period, the ton-miles of the railroad fleet also increased by a similar amount of 15.7 percent (table 1).

If the tons of revenue freight carried by the railroad fleet remained constant and the miles traveled increased, then the effect of roller bearings on overheated bearing failures for this period would be a small decline of about 5 percent (20 percent minus 15.7 percent). In this case, the increased use of roller bearings is offset by the increase in miles traveled. On the other hand, if the miles traveled remained constant and the tons of freight increased, then the effect of the increased use of roller bearings on the overheated bearing failure rate would be a maximum improvement of 20 percent. Since both the tons of freight and the miles traveled by the railroad fleet increased from 1976 to 1980, the net reduction in overheated journal bearing failures attributed to the increased use of roller bearings is between 5 percent and 20 percent for this period.

Hot Box Detectors and Train Use

The difference between an overheated journal bearing failure and an overheated journal bearing accident lies in detecting the overheating bearing before the journal itself overheats to the point of failure and causes a derailment. The Norfolk and Western (N&W) railroad compiled data from the years 1976 through 1980 on the two methods for detecting overheated journal bearings on its railroad: (1) by hot box detectors and (2) by traincrew and other employees. (See table 5.) (The N&W Railroad's fleet is equipped with approximately 70 percent roller bearings and 30 percent conventional solid bearings.)

Table 5.—Method By Which Overheated Journal Bearings Were Detected On the N&W.

Year	Detected by Hot Box Detector (#)	Total (%)	Detected by Traincrew and Other Employees (#)	Total (%)	Total (#)
1976	370	76	119	24	489
1977	351	71	142	29	493
1978	295	66	155	34	450
1979	396	73	145	27	541
1980	340	77	104	23	444
Totals	1,752	72	665	28	2,417

These data indicate that over the past 5 years hot box detectors have identified over 70 percent of the overheated journal bearings detected on the N&W system. Although this percentage cannot be extrapolated to apply universally to all railroads, it is indicative of the hot box detector's capability to locate overheated journal bearings in the railroad environment.

The hot box detector senses the temperature of each bearing by measuring the infrared energy it emits as the rail vehicle passes along the track. Bearings with temperatures in excess of 250° F (121° C) are generally considered potential failures. The conventional bearing, however, is surrounded by a lubricator and a container (journal box). When the hot box detector scans the journal box surface, the recorded temperature of the conventional bearing is much lower than the actual bearing temperature and makes the detection of a potential failure more difficult. Because the roller bearing is much more exposed, the hot box detector can more easily detect the actual bearing temperature and a potential failure.

However, roller bearings give far less visible warning when overheated than do conventional solid bearings. While a conventional solid bearing failure produces smoke and/or fire, the absence of smoke and/or fire in a roller bearing failure makes it difficult for a traincrew to identify an incipient failure, and also more difficult for railroad employees to observe when watching trains pass from their positions on the right of way. It would be helpful if some visible means could be devised to alert railroad employees of the presence of an overheated roller bearing.

Hot Box Detector

The infrared hot box detector is a result of World War II technology being adapted to a practical railroad application. The first commercially successful hot box detector was installed at Norge, Virginia, on the Chesapeake and Ohio Railroad in October 1956. At the present time, approximately 2,200 hot box detectors are in use on the nation's railroads and over 3,000 hot box detectors are in use on railroads throughout the world. One major railroad found that its hot box detectors located virtually all overheated bearings. Eighty percent of the trains stopped by the hot box detector had overheated bearings and in the other 20 percent of the trains stopped, other heat sources caused an overheated bearing indication. (Figure 1 shows a typical hot box detector installation.)

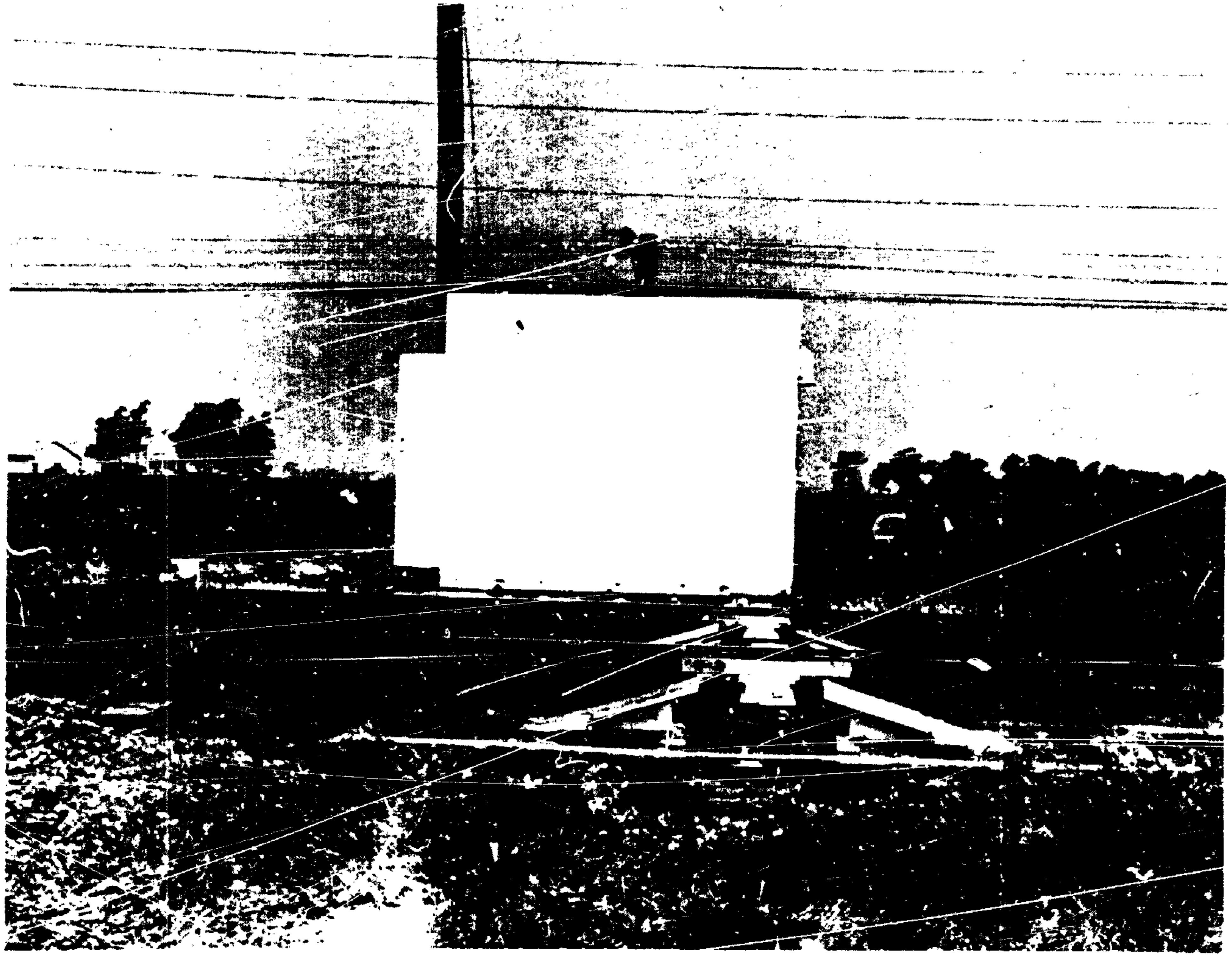


Figure 1.--Typical Hot Box Detector Installation.

The number of hot box detectors used on a given railroad depends mainly upon the resources that the railroad allocates to this type of equipment. Hot box detectors are usually located at entrances to yards and at strategic places on railroad property. Mechanical inspection crews at yard entrances use hot box detectors primarily to facilitate the inspection of inbound trains.

The spacing of hot box detectors on the line must be carefully selected for maximum benefit and efficiency. Since studies show that cars that have been set out of trains because of overheated journal bearings occur about 30 miles after leaving a yard, 3/ a 30-mile spacing throughout the railroad would probably be desirable and most beneficial. Currently, many railroads use the 30-mile spacing as a guide for hot box detector locations. In addition to the 30-mile spacing, approaches to bridges and tunnels should be protected with hot box detectors.

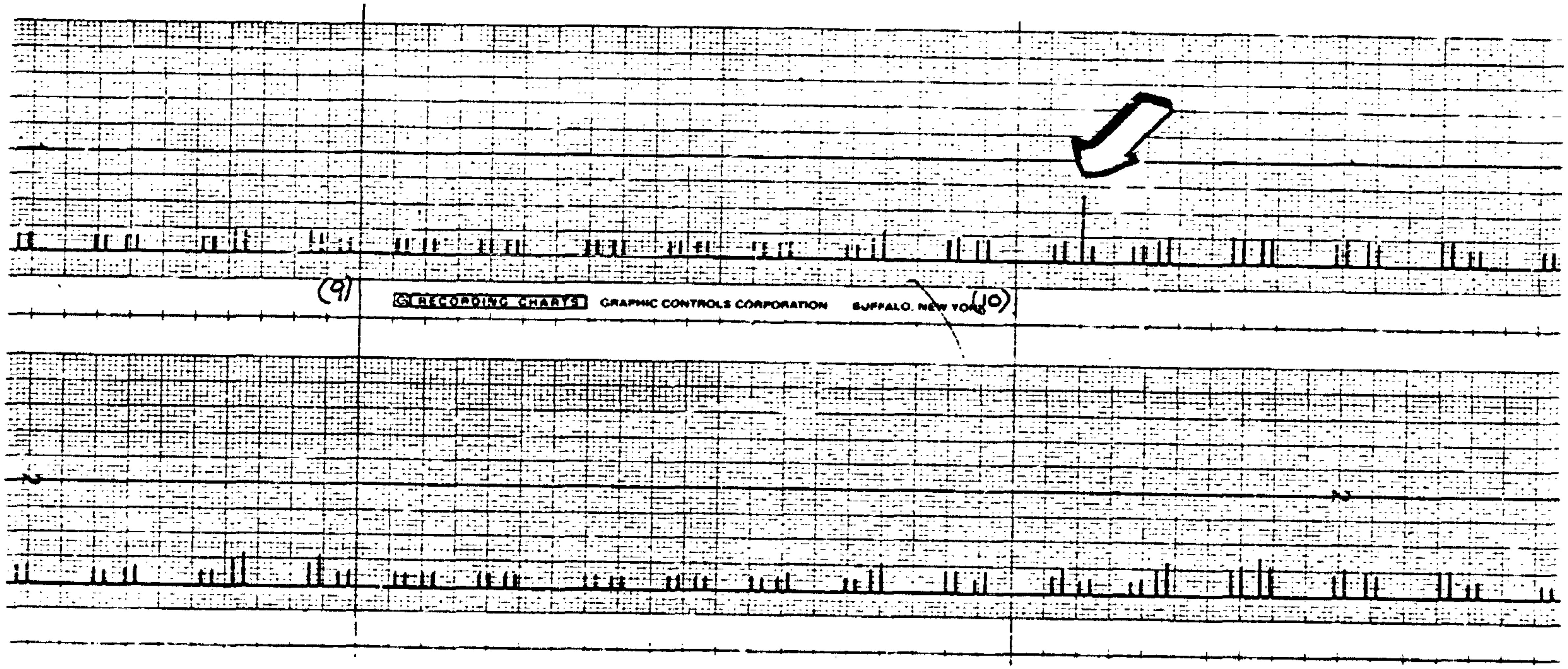
The three primary methods of hot box detector data handling are trackside displays, remote recorder displays, and computer generated radio contact.

Trackside Displays—Trackside displays use lights, audible signals, or both to alert crewmembers of an indication of an overheated journal bearing somewhere in the train. While such simple displays can be effective, a complete inspection of the train is required since the display only indicates that an overheated bearing exists and many trains are over a mile in length. To overcome this inadequacy, some trackside displays have digital readouts which indicate the first axle in the train which has an overheated journal bearing indication. While this is an improvement, the crew may be required to inspect the remainder of the train behind the indicated axle to be assured that there are no other overheated bearings.

Remote Recorder Displays—In remote recorder displays, the data from the hot box detector are transmitted to a strip chart recorder at a remote location where the individual temperature reading of each journal bearing on the train is displayed. An operator or technician inspects the tape for overheated bearing indications and notifies the traincrew of its location in the train. This system can incorporate a trackside light display to stop the train in conjunction with a wayside telephone by which a crewmember can call a designated person for the additional necessary information. Also, the information can be requested and transmitted by radio, if the railroad system is so equipped. Strip chart readouts from all trains can be telemetered to a central location if desired. Another advantage of this system is that communication is direct from the tape reader to the train without any intermediate individuals involved. Figure 2 shows a typical remote recorder display chart from a hot box detector and figure 3 shows a central hot box detector display system.

Computer Generated Radio Contact—These systems incorporate a radio link and a computer generated radio message from the hot box detector to the traincrew when an overheated bearing is indicated by the hot box detector. This system has the advantage of an immediate notification of an overheated bearing indication and eliminates the possibilty of human error in translating a readout. The railroads must decide the parameters for triggering the hot box detector communication circuitry when there are differences between bearing temperature readings. These parameters are usually based on two independent

3/ "The Fundamentals of Infrared Hot Box Detection" - E. G. Menaker, page 8 (unpublished).



Note:

Each vertical line represents an axle. The length of each vertical line represents the axle temperature.

Figure 2.--Typical Hot Box Detector Remote Recorder Display. (Arrow indicates overheated journal bearing.)

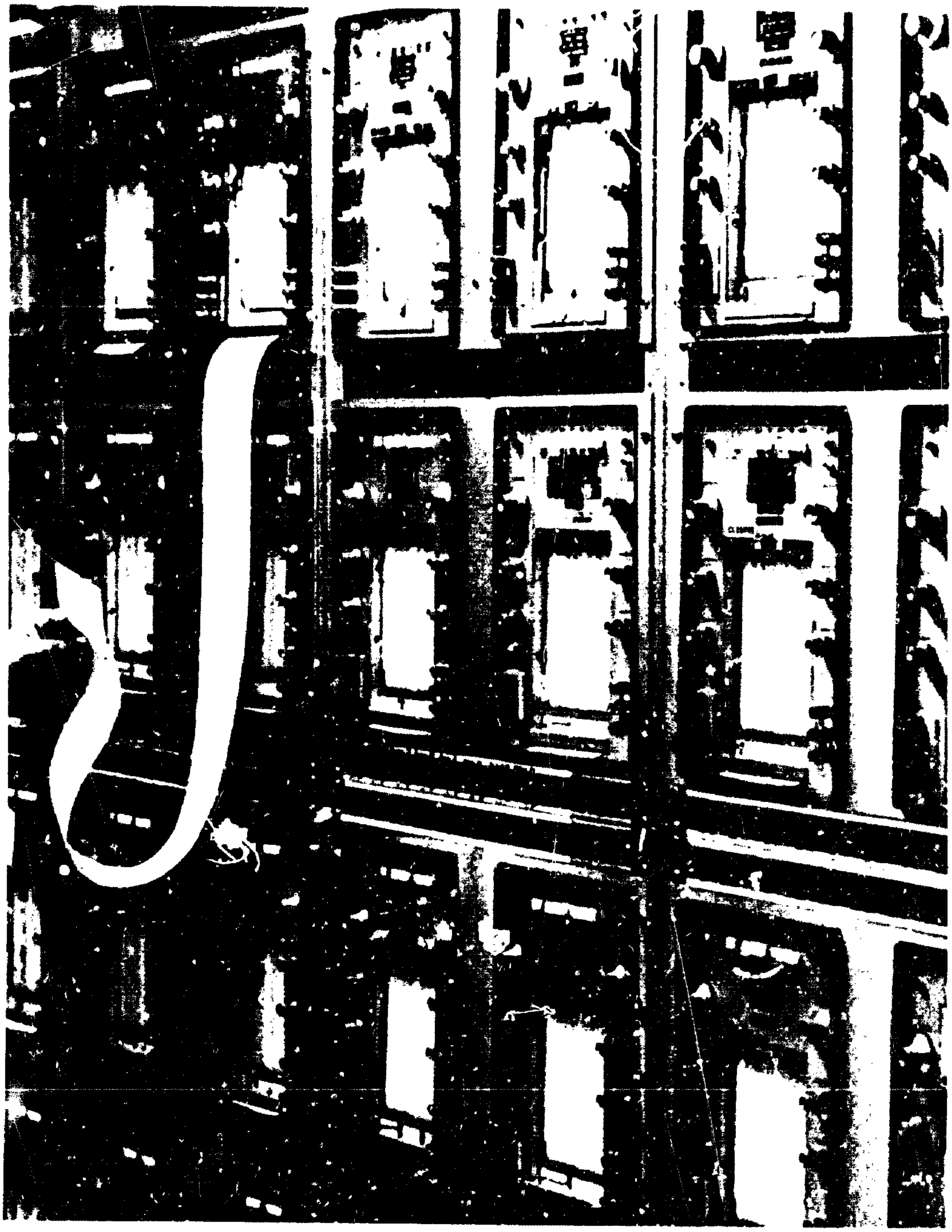


Figure 3.—Central Hot Box Detector Display System.

levels of temperature detection. The first detection level is a predetermined maximum temperature for any reading in the train. The second detection level is based on the difference between the detected temperatures on one side of the train and the temperature detected on the other side of the train. The determination of these two detection levels is based on the railroad's perception of the relative costs of stopping trains as compared to consequences related to undetected overheated journals.

Recent Accident History of Mismanagement of Hot Box Detector Data

While the value of the hot box detector has been established as a tool to locate overheated journal bearings, the Safety Board is becoming increasingly concerned with the handling of hot box detector data after an overheated journal bearing has been identified. During the past 5 years, the Safety Board has investigated nine accidents in which overheated journal bearings that had been previously identified by trackside hot box detectors resulted in derailments. (See table 6.) Three of these accidents occurred in the first 5 months of 1981. The following is a synopsis of each of the nine accidents:

On December 20, 1976, a derailment occurred at Northbrook, Illinois, on the Chicago and Northwestern Railroad. The train had been stopped by the dispatcher 20 miles before the derailment location for inspection of an overheated journal bearing on the 14th car from the locomotive. An inspection by the traincrew failed to uncover the potentially hazardous overheated journal bearing and the train proceeded. The cause of the derailment at Northbrook was a broken journal on the 14th car from the locomotive due to a bearing overheating. No personal injuries resulted from the accident. Property damage was estimated at $605,000.

On December 25, 1978, a derailment occurred on the Chicago and Northwestern Railroad at Cedar Rapids, Iowa. A hot box detector identified an overheated journal bearing in the train but the employee who read the tape display took no action to stop the train. A broken journal on the car identified by the hot box detector caused the derailment. There were no personal injuries from this accident. Property damage was estimated at $316,000.

On March 15, 1979, a derailment occurred on the Chicago, Milwaukee, St. Paul and Pacific Railroad at Franksville, Wisconsin. A hot box detector had previously identified an overheated journal bearing in the train; however, the information forwarded to the traincrew incorrectly identified both the location of the car and the side of the train on which the overheated journal bearing was located. The traincrew inspected the train using the incorrect information and did not find the overheated bearing. The train proceeded and subsequently derailed because of a journal bearing failure. There were no personal injuries as a result of this accident. Property damage was estimated at $190,000.

On May 28, 1979, a derailment occurred on the Burlington Northern Railroad at Hanover, Illinois. The hot box detector indicated an overheated journal bearing on a wayside display. The traincrew correctly computed the location as the 57th car from the locomotive but failed to verify the presence of an overheated bearing on the car. The train derailed due to a broken journal on the 57th car from the locomotive. There were no personal injuries as a result of the accident. Property damage was estimated at $385,000.

On August 20, 1980, a derailment occurred on the Burlington Northern Railroad at Cassville, Wisconsin. The hot box detector had previously indicated an overheated journal bearing on a wayside display. The traincrew did not correctly compute the bearing's location from the number indicated on the wayside display and failed to verify the

RAILROAD INVOLVED	ACCIDENT LOCATION	DATE	KILLED	INJURED	DAMAGE $(000)	CIRCUMSTANCES WHICH RESULTED IN ACCIDENT	CATEGORY OF HOT BOX DETECTOR DATA MISMANAGEMENT
CHICAGO NORTHWESTERN	NORTH [illegible]OOK, ILLINOIS	12/20/76	0	0	605	HOT BOX DETECTOR INDICATED OVERHEATED BEARING. TRAIN WAS STOPPED BY DISPATCHER TO INSPECT 14th CAR FROM LOCOMOTIVE. CAR INSPECTED AND TRAIN PROCEEDED. 20 MILES LATER TRAIN DERAILED DUE TO BROKEN JOURNAL ON 14th CAR.	(4) CREW DID NOT IDENTIFY BEARING AS OVERHEATED.
CHICAGO NORTHWESTERN	CEDAR RAPIDS, IOWA	12/25/78	0	0	316	HOT BOX DETECTOR INDICATED OVERHEATED JOURNAL BEARING BUT OPERATOR FAILED TO NOTIFY DISPATCHER TO STOP TRAIN. BROKEN JOURNAL ON DETECTED CAR CAUSED DERAILMENT.	(3) LACK OF APPROPRIATE ACTION BY READER OF HOT BOX DETECTOR TAPE.
MILWAUKEE	FRANKSVILLE, WISCONSIN	3/15/79	0	0	190	HOT BOX DETECTOR INDICATED OVERHEATED JOURNAL BEARING REPORT TO TRAIN GAVE WRONG CAR & WRONG SIDE OF TRAIN. BRAKEMAN INSPECTED ONLY ONE SIDE OF TRAIN. TRAIN PROCEEDED & DERAILED DUE TO BROKEN JOURNAL.	(1) INCORRECT INFORMATION FURNISHED TO TRAIN CREW.
BURLINGTON NORTHERN	HANOVER, ILLINOIS	5/28/79	0	0	385	HOT JOURNAL BEARING INDICATED ON WAYSIDE DISPLAY. TRAIN CREW INSPECTED 57th CAR FROM LOCOMOTIVE AND FOUND NOTHING. TRAIN PROCEEDED AND DERAILED 34 MILES LATER DUE TO BROKEN JOURNAL ON 57th CAR.	(4) CREW DID NOT IDENTIFY BEARING AS OVERHEATED.
BURLINGTON NORTHERN	CASSVILLE, WISCONSIN	8/20/80	0	0	744	HOT JOURNAL BEARING INDICATED ON WAYSIDE DISPLAY. LOCATION INCORRECTLY COMPUTED BY CREW. HOT JOURNAL BEARING NOT LOCATED. TRAIN PROCEEDED AND DERAILED DUE TO BROKEN JOURNAL.	(2) CREW MISINTERPRETED INFORMATION ON WAYSIDE DISPLAY.
LOUISVILLE & NASHVILLE	UPTON, INDIANA	10/25/80	0	1	1,080	HOT JOURNAL BEARING INDICATED ON WAYSIDE DISPLAY. LOCATION INCORRECTLY COMPUTED BY CREW. HOT JOURNAL BEARING NOT FOUND. TRAIN PROCEEDED AND DERAILED DUE TO BROKEN JOURNAL	(2) CREW MISINTERPRETED INFORMATION ON WAYSIDE DISPLAY.
ILLINOIS CENTRAL GULF	BUCKLEY, ILLINOIS	2/14/81	0	0	238	HOT JOURNAL BEARING INDICATED ON DETECTOR TAPE. TAPE READ AND SIGNED BUT NO ACTION TAKEN BY OPERATOR. TRAIN SUBSEQUENTLY DERAILED DUE TO BROKEN JOURNAL.	(3) LACK OF APPROPRIATE ACTION BY READER OF HOT BOX DETECTOR TAPE.
GRAND TRUNK WESTERN	MARCELLUS, MICHIGAN	3/5/81	0	0	292	HOT JOURNAL BEARING INDICATED ON WAYSIDE DISPLAY. LOCATION INCORRECTLY COMPUTED BY CREW. HOT JOURNAL BEARING NOT FOUND. TRAIN PROCEEDED & DERAILED DUE TO BROKEN JOURNAL.	(2) CREW MISINTERPRETED INFORMATION ON WAYSIDE DISPLAY.
ILLINOIS CENTRAL GULF	DOWELL, ILLINOIS	5/3/81	0	0	950	TRAIN STOPPED TWICE BY CHICAGO CENTRAL CONTROL TO INSPECT 50th CAR FROM LOCOMOTIVE FOR OVERHEATED JOURNAL BEARING FOUND NOTHING. TRAIN PROCEEDED AND DERAILED DUE TO BROKEN JOURNAL ON 50th CAR FROM LOCOMOTIVE.	(4) CREW DID NOT IDENTIFY BEARING AS OVERHEATED.
TOTAL	9		0	1	4,800		

Table 6.--Accidents in which hot box detector located hot journal bearing but subsequent actions by carrier and crew did not prevent accident.

presence of an overheated bearing. The train subsequently derailed as a result of a journal bearing failure. There were no personal injuries as a result of the accident. Property damage was estimated at $744,000.

On October 25, 1980, a derailment occurred on the Louisville and Nashville Railroad at Upton, Indiana. The hot box detector had previously indicated an overheated journal bearing on a wayside display. The traincrew incorrectly computed the location of the overheated bearing, and thus failed to locate it. The train proceeded and subsequently derailed due to a broken journal. There was one personal injury to a crewmember. Property damage was estimated at $1,080,000.

On February 14, 1981, a derailment occurred at Buckley, Illinois, on the Illinois Central Gulf Railroad. The hot box detector tape display indicated an overheated journal bearing. The operator read and signed the tape but took no action. The train subsequently derailed due to a broken journal which had been overheated. There were no personal injuries as a result of the accident. Property damage was estimated at $238,000.

On March 5, 1981, a derailment occurred at Marcellus, Michigan, on the Grand Trunk Western Railroad. The hot box detector indicated the location of an overheated journal bearing on a wayside display but the actual location of the potentially hazardous bearing was incorrectly computed by the traincrew. The overheated bearing was not located when the train was inspected. The train proceeded and subsequently derailed due to a journal failure. There were no personal injuries. Property damage was estimated at $292,000.

On May 3, 1981, a broken journal resulted in a derailment at Dowell, Illinois, on the Illinois Central Gulf railroad. The train involved had been previously stopped twice for inspection of the 50th car from the locomotive. Two different traincrews inspected the train. Neither traincrew located the bearing which eventually failed on the 50th car from the locomotive. There were no personal injuries as a result of the accident. Property damage was estimated at $950,000.

Although the circumstances for each derailment were different, the causal factors involved the manner in which the hot box detector data were handled and fall into one of the following four categories:

(1) Improper identification of car location given to the traincrew by the reader of the displayed hot box detector information.

The March 15, 1979 accident at Franksville, Wisconsin, on the Milwaukee Railroad is the only accident that fell in this category. The traincrew was given incorrect information and as a result the crew did not locate the overheated journal bearing.

(2) Improper action by traincrews in interpreting the hot box detector information.

In three of the nine accidents, the traincrew misinterpreted the hot box detector information. Each of these accidents involved a wayside display which indicated the number of the axle which contained the overheated bearing (counted from the rear of the train). The crewmembers at the rear of the train observed the number and determined the location of the overheated bearing from either end of the train based on their knowledge of the number of cars in the train. Because a train may have both four- and six-axle cars (there are a few two-axle cars but they are rare) and because an accurate car count may not be available on all trains due to the removal and addition of cars between terminals, accurately determining the location of the overheated journal bearing based on axle count is sometimes difficult.

(3) The lack of appropriate action by the reader of the hot box detector tape display.

In two of the nine train accidents, the reader of the hot box detector tape display failed to take appropriate action. One individual read and marked the tape correctly but failed to take action to have the train stopped. The other individual failed to detect the presence of the overheated journal on the tape display. The amount of employee training was not determined. The type and extent of instructions concerning the reading of hot box detector tapes is not known.

(4) Inability of traincrew to identify an indicated bearing as being overheated.

In three of the nine accidents, the crewmembers that inspected the trains could not identify the overheated bearings in the train. Instructions to crews vary concerning the method for detecting hot bearings. Some railroads instruct crews to touch the bearings with their hands, others indicate use of a gloved hand. Other railroads issue crayons which melt at given temperatures to help traincrews determine the actual temperature of a bearing. During inclement weather, delays in inspecting an indicated overheated bearing may allow sufficient time for the bearing to cool, and thus prevent its detection. In territory where heavy braking is required, traincrews may misinterpret the heat from brake shoes when comparing journal bearing temperatures.

The role of train crewmembers in the use of hot box detector data requires emphasis. In six of the nine accidents, the action of the train crewmembers was a critical element in the derailment sequence. Some railroads consider that allowing train crewmembers to make decisions on hot box detector data is too great a risk and instead issue instructions that all cars identified as having overheated journal bearings must be set out of the train. Such cars are examined by railroad mechanical personnel before being placed back into service.

The Safety Board is concerned that the use of data from hot box detectors is not adequate to insure maximum safety and to prevent future accidents. The Safety Board believes that all personnel (train crewmembers and readers of hot box detector information) should be properly trained and instructed and that procedures should be established regarding the proper use of all data obtained from hot box detector systems.

While none of the derailments discussed in this report could be considered serious by railroad standards, there is a possibility that a serious or even catastrophic accident could occur if the management of hot box data on these railroads is not improved.

CONCLUSIONS

1. The U.S. railroads have made substantial progress in the last few years in reducing accidents caused by overheated journal bearings.

2. The effect of roller bearings on the decline of overheated journal bearing accidents from 1976 to 1980 is related to the longer service life of roller bearings and their increased use in the railroad fleet (12 percent).

3. The hot box detector has played a major role in reducing accidents that result from overheated railroad journal bearings.

4. Train crewmembers have difficulty in correctly locating and identifying overheated journal bearings that have been indicated by hot box detectors.

5. Overheated roller bearings are more difficult for crewmembers to identify than overheated conventional solid bearings.

6. Railroad personnel who read the hot box detector display tape have relayed incorrect overheated bearing information to train crewmembers.

7. Maximizing the use of hot box detectors and improving the use of hot box detection data could lead to a further reduction of accidents resulting from overheated journal bearings.

8. Adequate training and proper control and follow-up procedures in handling hot box detector data are critical to the success of a hot box detector program.

RECOMMENDATIONS

As a result of the findings and conclusions of this Special Investigation, the National Transportation Safety Board made the following recommendations:

--to the following railroads: Chicago and Northwestern Transportation Company; Chicago, Milwaukee, St. Paul, and Pacific Railroad Company; Burlington Northern Railroad; Louisville and Nashville Railroad; Illinois Central Gulf Railroad; and Grand Trunk Western Railroad Company:

> Review and evaluate training and procedures for handling hot box detector data to ensure that correct action is taken to accurately determine the location of the bearing in the train and that the train is properly inspected when an overheated journal bearing is identified. (Class II, Priority Action) (R-81-84)
>
> Establish a method for determining and verifying that actions taken to prevent journal failure when an overheated bearing is indicated by a hot box detector are of a sufficient and acceptable quality. (Class II, Priority Action) (R-81-85)

--to the Association of American Railroads:

> Initiate research to devise a visible means on or near the bearing mounting surface or box to alert railroad employees of the presence of overheated roller bearings and conventional solid bearings that have been identified by a hot box detector. (Class II, Priority Action) (R-81-86)
>
> Advise its member railroads of the circumstances of the accidents described in this special investigation and urge them to evaluate their existing training and procedures for handling hot box detector data and to make any changes deemed appropriate to achieve further reduction of overheated journal bearing accidents. (Class II, Priority Action) (R-81-87)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ ELWOOD T. DRIVER
Vice Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ PATRICIA A. GOLDMAN
Member

JAMES B. KING, Chairman, and G. H. PATRICK BURSLEY, Member, did not participate.

August 11, 1981

APPENDIXES

APPENDIX A

Miles Per Overheated Journal-Bearing */
(U. S. Railroads)

Year	Roller Bearing (Miles (000))	Conventional Bearing (Miles (000))
1970	19,106	1,050
1971	15,400	1,108
1972	14,594	976
1973	15,779	901
1974	16,335	828
1975	14,037	703
1976	15,687	726
1977	14,476	720
1978	14,334	751
1979	15,476	653
1980	16,156	711

*/ Source: Association of American Railroads.

APPENDIX B

Because the railroad fleet is equipped with two different types of journal bearings with different overheated bearing failure rates, an increase in the use of one bearing over the other will change the average overheated bearing failure rate for the railroad fleet. By using a weighted average approach, the effect of a 12-percent increase in use of roller bearings from 1976 to 1980 on the fleet average miles per overheated bearing failure is calculated as follows:

$$(\% * \text{miles/failure})_{r.b.} + (\% * \text{miles/failure})_{s.b.} = \text{fleet aver. miles/failure}$$

where % = percent of bearing type in the railroad fleet
r.b. = roller bearing
s.b. = conventional solid bearing

The percent composition figures are from table 4 and the miles per failure are from Appendix A.

1. For 1976, the fleet average miles per overheated bearing failures was 10.3×10^6.

$$.64(15.7 \times 10^6) + .36(0.7 \times 10^6) = 10.30 \times 10^6$$

2. For 1980, the fleet average miles per overheated bearing failure was 12.4×10^6.

$$.76(16.1 \times 10^6) + .24(0.7 \times 10^6) = 12.40 \times 10^6$$

3. From 1976 to 1980, the fleet average miles per overheated bearing failure increased 20%.

$$\frac{(12.4 - 10.3)}{10.3} \times 100 = 20.4\%.$$

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